REMARKS

Applicants have received and reviewed the Office Action dated March 30, 2009.

By way of response, Applicants have cancelled claims 2 and 14 without prejudice or disclaimer. Applicants reserve the right to pursue these claims in one or more continuation applications.

Claims 1, 4, 6, and 19 have been amended. The amendments are supported throughout the specification including at page 5, line 17 to page 6, line 18; and page 14, lines 6 to 16.

35 U.S.C. § 103(a)

Claims 1-3, 5, 7-13 and 17-19 were rejected under 35 U.S.C. § 103(a) over Boernert et al, US 6,317,619 in view of Haishi et al., 1999. Applicants traverse the rejection.

The recent Supreme Court case, KSR Int 'I Co. v. Teleflex, Inc., 127 S. Ct. 1727, 1734 (2007), sets forth the legal standard for obviousness. This case reaffirms the analytical framework set out in Graham v. John Deere Co. of Kansas City, 383 U.S. 1 (1966), which mandates that an objective obviousness analysis includes: (1) determining the scope and content of the prior art; (2) ascertaining the differences between the prior art and the claims at issue; and (3) resolving the level of ordinary skill in the pertinent art. Id. at 1734. Secondary considerations such as commercial success, long felt but unsolved needs, or failure of others may also be persuasive.

In rejecting claims under 35 U.S.C. § 103(a), the Examiner bears the initial burden of establishing a prima facie case of obviousness. In re Oetiker, 977 F.2d 1443, 1445 (Fed. Cir. 1992). Only if this initial burden is met does the burden of coming forward with evidence or argument shift to the appellant. Id. at 1445. Obviousness is then determined on the basis of the evidence as a whole and the relative persuasiveness of the arguments. See Oetiker, 977 F.2d at 1445. One criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that claimed subject matter should be carried out and would have a reasonable likelihood of success viewed in light of the prior art. In re Dow Chem. Co., 837 F.2d 469, 473 (Fed. Cir. 1988).

"It remains important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does". KSR Int'l Co. v. Teleflex, Inc., 127 S. Ct. 1727, 1741 (2007). "Hindsight" is inferred

when the specific understanding or principal within the knowledge of one of ordinary skill in the art leading to the modification of the prior art in order to arrive at appellant's claimed invention has not been explained. In re Rouffet, 149 F.3d 1350, 1358 (Fed. Cir. 1998). The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. In re Fritch, 972 F.2d 1260, 1266 (Fed. Cir. 1992). The claimed subject matter is nonobvious if it involves a number of complex and unpredictable alternatives and there is no reason one of skill in the art would select one alternative over another. Ortho-McNeil vs. Mylan, Inc, 520 F.3d 1358, 1364 (Fed. Cir. 2008).

The combination of references must also suggest the claimed subject matter would have a reasonable likelihood of success. In the case of Abbott Labs. v. Sandoz, Inc., the Federal Circuit stated:

"The court in KSR did not create a presumption that all experimentation in fields where there is already a background of useful knowledge is "obvious to try", without considering the nature of the science and technology. The methodology of science and the advance of technology are founded on the investigator's educated application of what is known, to intelligent exploration of what is not known. Each case must be decided in its particular context, including the characteristic of the science and technology, its state of advance, the nature of known choices, the specificity and generality of the prior art and the predictability of results in the area of interest." Abbott Labs. v. Sandoz, Inc., 2008 U.S. App. LEXIS 21880 page 7 (Fed. Cir., Oct. 21, 2008).

Claim 1 is directed to a method of producing volume renderings from magnetic resonance image data in real time with user interactivity, the method comprising:collecting magnetic resonance image (MRI) from a magnetic resonance coil, the MRI data representative of shapes within an image volume; transferring the MRI data to a computer; and producing a three-dimensional rendering of a volume from the MRI data in real time with respect to the act of collecting MRI data from a magnetic resonance coil representative of shapes within the image volume by rendering a plurality of image slices; wherein collecting MRI data, and transferring MRI data is performed continuously; and displaying the three-dimensional volume rendering on a monitor at a rate of about 10 or more frames per second with low latency.

Claim 19 is directed to an apparatus for producing three-dimensional volume renderings from magnetic resonance image data in real time, the apparatus comprising:a magnetic resonance image (MRI) scanner having a magnetic resonance coil configured to generate MRI data representative of shapes within an image volume; a pulse sequence generator in communication with the magnetic resonance coil and configured to execute a pulse sequence using view sharing between even and odd echoes; and a computer in data communication with the MRI scanner, the computer configured to receive the MRI data from the MRI scanner and to produce a three-dimensional rendering of a volume from a plurality of image slices from the MRI data in real time with respect to an act of collecting the MRI data from the magnetic resonance coil.

The Boernert reference does not disclose all of the elements of the claims. The Boernert reference does not disclose 3D rendering or displaying the three-dimensional volume rendering on a monitor at a rate of about 10 or more frames per second with low latency. Many references to 3D in this document relate to identifying the position or location of the image by determining the location of the RF coil. The actual images are described as one dimensional, two dimensional, or linear. There is no specific discussion in this reference of the parameters or processing of the data necessary to generate a 3D rendering of a volume in real time.

The deficiencies of Boernert are not remedied by reference to Haishi. This reference also does not disclose displaying the three-dimensional volume rendering on a monitor at a rate of about 10 or more frames per second with low latency. In addition, Haishi does not teach or suggest the parameters and processing of the data necessary to provide real time volume rendering. Haishi describes the fastest parameters to run the system (36 ms, using 128x128 matrix) for 2D images. In the case of a 3D data set (64x64x64 matrix), the time is about 2 seconds. He shows 3D images of a phantom (enhanced water in tubes or bottles) with ideal properties. This resolution would not be close to producing useful images inside a body. In addition, Haishi requires acquisition of an entire 3D data set before image construction and would not be capable of the performance of the methods and apparatus as claimed herein.

Moreover, there is no reason to combine the two references as they are directed to solving different problems. The Boernert reference is directed to a system that allows the user to interactively define regions of interest to be imaged but does not disclose 3D rendering. In the system of Boernert, the 3D position of the coil holder needs to be determined in order to determine and control magnetic field gradient pulses and RF pulses to excite nuclear

magnetization in the determined region. The Haishi reference is directed to an imaging system that is focused on fast data acquisition and real time volume rendering. Neither reference gives any indication whether the constraints on magnetic gradient pulses and RF pulses in the system of Boernert would be compatible with fast acquisition and real time volume rendering of Haishi. Moreover, there is no indication that any of the parameters of the references combined would produce useful images in a body.

Applicants request withdrawal of the rejection on this basis.

Claims 4 and 6 were rejected under 35 U.S.C. § 103(a) over Boernert et al. and Haishi as applied to claim 1, further in view of NessAiver, US 5,329,925. Applicants traverse the rejection.

The Boernert and Haishi references in combination are discussed above and those arguments are incorporated by reference herein.

The deficiencies of those references are not remedied by reference to NessAiver. NessAiver is directed to reducing scan time of magnetic resonance cine images, but does not teach or suggest producing volume renderings or producing such renderings in real time with respect to the collection of data. The Nessaiver reference does not disclose displaying the three-dimensional volume rendering on a monitor at a rate of about 10 or more frames per second with low latency. In addition, this reference talks about imaging but does not describe 3D rendering. There is no specific discussion in this reference of the parameters or processing of the data necessary to generate a 3D rendering of a volume in real time.

Even if the references could be combined there would be no reasonable expectation of success because generating 3D volume renderings in real time involves a number of complex and unpredictable alternatives and there is no reason one of skill in the art would select one alternative over another. Real time volume rendering requires a balancing of factors including scan rate, points samples per echo, the number of echoes per excitation, the flip angle, the slice thickness, and the size of pixels. See the specification at page 14, lines 17-21. In addition, real time techniques are very memory and computation intensive. See Pfister at page 1, column 2. There is no showing in the combined references that techniques from one type of imaging task (ie reducing scan time of cine images) can be readily substituted in 3D volume rendering methods and devices.

Applicants request withdrawal of the rejection on this basis.

Claims 14 and 15 were rejected under 35 U.S.C. § 103(a) over Boernert et al. and Haishi as applied to claim 1, further in view of Pfister, 1999. Claim 14 has been cancelled rendering the rejection of this claim moot. Applicants traverse the rejection with respect to claim 15.

The Boernert and Haishi references in combination are discussed above and those arguments are incorporated by reference herein.

The deficiencies of those references are not remedied by reference to Pfister. Pfister is directed to mapping texture on volume renderings. With respect to real time, the only disclosure is at col. 2, lines 14-18, which states only that hardware accelerators *aim* to provide real-time frame rates when operating on previously collected data — not that it provides real-time volume renderings with respect to MRI data collected in real time. Nor does it teach how the system would achieve real-time frame rates.

Pfister discloses imaging based on previously collected data, while the pending claim covers imaging based on data as it is being collected from a coil. In addition, Pfister does not teach or suggest the parameters and processing of the data necessary to provide real time volume rendering.

Even if the references could be combined there would be no reasonable expectation of success because generating 3D volume renderings in real time involves a number of complex and unpredictable alternatives and there is no reason one of skill in the art would select one alternative over another. Real time volume rendering requires a balancing of factors including scan rate, points samples per echo, the number of echoes per excitation, the flip angle, the slice thickness, and the size of pixels. See the specification at page 14, lines 17-21. In addition, real time techniques are very memory and computation intensive. See Pfister at page 1, column 2. There is no showing in the combined references of the parameters and processing of the data necessary to provide real time volume rendering.

Applicants request withdrawal of the rejection on this basis.

Claims 15 and 16 were rejected under 35 U.S.C. § 103(a) over Boernert et al. and Haishi as applied to claim 13, further in view of Deering, US 6,417,861. Applicants traverse the rejection.

The Boernert and Haishi references in combination are discussed above and those arguments are incorporated by reference herein.

The deficiencies of those references are not remedied by reference to Deering. Deering does not disclose rendering an image in real time with respect to collecting MRI data from a magnetic resonance coil. In fact, Deering teaches away from the claimed invention. Deering teaches a graphics architecture that constructs images from previously acquired data. Real-time for the Deering architecture is a function performed at or near the refresh rate of a display device, col. 4, lines 35-37, not with respect to the collection of data. It also does not make any disclosure about magnetic resonance imaging or MRI data.

Even if the references could be combined there would be no reasonable expectation of success because generating 3D volume renderings in real time involves a number of complex and unpredictable alternatives and there is no reason one of skill in the art would select one alternative over another. Real time volume rendering requires a balancing of factors including scan rate, points samples per echo, the number of echoes per excitation, the flip angle, the slice thickness, and the size of pixels. See the specification at page 14, lines 17-21. In addition, real time techniques are very memory and computation intensive. See Pfister at page 1, column 2. There is no showing in the combined references of the parameters and processing of the data necessary to provide real time volume rendering.

Summary

In view of the above amendments and remarks, Applicant respectfully requests a Notice of Allowance. If the Examiner believes a telephone conference would advance the prosecution of this application, the Examiner is invited to telephone the undersigned at the below-listed telephone number.

Respectfully submitted,

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